Comments of Wendell Christensen
Before the
Technical Study Panel on the Utilization of Belt Air
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Good afternoon. My name is Wendell Christensen and I am the electrical maintenance manger for UtahAmerican Energy. I have worked in the mining industry since 1979, always in some sort of capacity dealing with electrical equipment. I have more than 25 years of experience with mine monitoring systems of various types. During that time I have been involved with the development, installation and upgrades of the AMS systems of many of the western mines, including Beaver Creek, Trail Mountain, West Elk, Skyline, SUFCO, Dugout, Tower, West Ridge and Crandall.

You have heard from many companies and individual mines about how and why they were granted their belt air and two-entry petitions. My focus is going to be on the electrical and electronic advances that have occurred in the mining industry relevant to belt lines and atmospheric monitoring systems.

In the late 1970's and early 80's mines began replacing heat type fire sensors used for belt line monitoring. The new systems (AMR, Conspec, Mundex, MSA, Pyott Boone and others) used carbon monoxide sensors allowing continuous monitoring of belt lines. At first there were only a few types of sensors available (carbon monoxide and methane). These were a major improvement; they were more sensitive and reliable than the old point type heat sensors. They gave you the ability to set alarms at a particular CO level, not a set temperature as available on point-type heat sensors. Carbon monoxide sensors were installed at each drive location and at 1000-foot intervals along the belts. A computer on the surface monitored CO levels of the air in the belt line and could warn the affected working sections of increased CO levels. An ambient CO level of 5 ppm was established for the mines and alarm levels established. Warning levels were set at 10 ppm, 5 ppm above ambient. Alarm levels were set at 15 ppm, 10 ppm above ambient. These systems were DOS-based and allowed a limited amount of points (127) to be

monitored per trunk. These systems were extremely slow and allowed very little change from the manufacturer's canned program.

Mine wide monitoring systems have since made large-scale improvements through the years. Systems now monitor many conditions, both environmental and operational, in the mines. Because of the need to comply with belt air petitions and the sophisticated monitoring equipment required for it, these improvements have progressed much more rapidly than they otherwise would have.

Belt air petitions required sensitive carbon monoxide (CO) sensors to be installed at prescribed intervals along the belt, depending on belt air velocity. These sensors could include, or be in addition to, existing sensors. Slower air velocities required the sensors be installed at 300-foot intervals instead of the 1,000 foot intervals. In addition to the sensors installed along the belt, sensors were also installed in the intake entry where the intake air entered the belt entry (the point feed), and in the belt entry just outby and inby the point feed. This results in monitoring the air entering the belt, the air already in the belt and the combined air after the two mix. Additionally, alarms were installed at the working sections to provide both visual and audible alerts to the miners working at the face in the event CO levels rose above the legal limits.

Two-entry petitions require additional sensors be employed. CO discriminating sensors are now installed at 1,000-foot intervals in the intake entry in addition to the belt entry. These additional sensors are required from the conveyor drive to the working faces. Also, the intake air used to ventilate a two-entry section is monitored the last 4,000 feet before it enters a two-entry section (at 1,000-foot intervals). In addition, during development when the belt line is used as return, methane sensors are required: one at the tail of the belt where air leaves the section and enters the belt line and another at the point where the belt air dumps into the return.

Alarm and warning levels for CO on belt air and two-entry system belts have been re-evaluated and lowered. Depending on the conditions and sampling of the mine, ambient levels as low as 2 ppm are now used in some places on belts making typical warning levels 7 ppm and alarm levels 12 ppm.

Systems now interface with environmental monitors, PLC equipment and processors to monitor and control the mine. State of the art graphical interfaces, fiber optics trunk lines, radio and wireless technology allow monitoring of more than 32,000 points in a single mine with polling times of less than one second. Current systems now include continual self-diagnostic capabilities.

Sensors have evolved from the first rudimentary CO and methane sensors to discriminating sensors, infra-red technology and many specialized sensors: air velocity, pressure differential, H2S and hydrocarbons just to name a few.

The mine wide monitoring system also has the ability to control devices underground such as stopping conveyor belts and removing electrical power from selected areas of the mine. This is a safety and operational enhancement that is built off the environmental monitoring platform. If CO is observed moving down a belt line, the belt can be shut off by the monitor operator and potentially halt a heating or friction problem that is developing. In addition, as everyone knows, shutting down the belts is an effective way to get the attention of miners underground, so this ability adds a way to quickly notify miners in an affected area of a problem.

The systems are monitored by a trained individual 24 hours a day, 7 days a week; also an electrician trained in system operation and maintenance is available on all shifts. Not only are the system operators trained to respond to alarms, but to also analyze conditions that may indicate possible problems before they have a chance to escalate into alarm conditions, and they always know who the Responsible Person is on shift and how to contact him. The system has on numerous occasions proven its value by detecting hot belt idlers and hot equipment before a fire has occurred. Further, the system has helped locate and analyze diesel equipment that is not performing properly. We have installed CO sensors and temperature probes in compressor stations, regardless of the fact that they are already housed in fire proof rooms, and we monitor electrical installations along primary escape routes, and other applications that are too many to list. These are not required by regulation, but I have found that when a mine installs a good AMS system,

that the mine personnel come up with all sorts of ways to use it to make the mine safer and more efficient.

Through the use of live-time graphical representations of the equipment status and environmental monitoring, the system helps us make quick and accurate decisions based on real-time information. With the system's ability to set multiple warning and alarm levels, we can have warning settings below the required limits. From these warnings the operator is alerted to potentially dangerous conditions, thus allowing us to investigate and control situations before they develop into a problem. We use the system to help determine the importance of an alarm, the required response, and the proper personnel to respond to the alarm.

We believe that the utilization of belt air is safe and that it is, in fact, safer because of the requirement to install an AMS system. By virtue of the use of two-entry gateroads, ground control is improved, air quality is required to be continuously and carefully monitored, and responses to problems are expedited. Without the monitoring system as required by the use of belt air, our ability to know what is going on in the mine at any instant would be reduced and the safety of the miners would be likewise reduced.

I appreciate the opportunity to enter these comments.